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**Osaki**

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(54) **VEHICLE**

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***B60K 17/08*** (2006.01)
***B60K 5/02*** (2006.01)
***B60K 17/02*** (2006.01)
***B60K 20/02*** (2006.01)
***F16H 59/00*** (2006.01)
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(58) **Field of Classification Search**
CPC ..... B60K 17/02; B60K 17/04
USPC ..... 180/292
See application file for complete search history.

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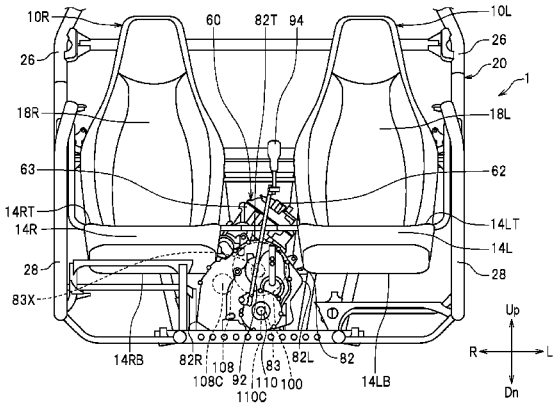
(57) **ABSTRACT**

An ROV includes a body frame, first and second seats each including a seating portion, an engine disposed rearward relative to the seating portions and supported by the body frame, a transmission including a drive shaft and a main shaft configured to rotate by receiving a driving force from a crankshaft, and a transmission case provided as a component separate from the engine and spaced away from the engine and in which the transmission is contained. At least a portion of the transmission case is disposed between the seating portions and above a lower end of the seating portion and a lower end of the seating portion.

**10 Claims, 7 Drawing Sheets**



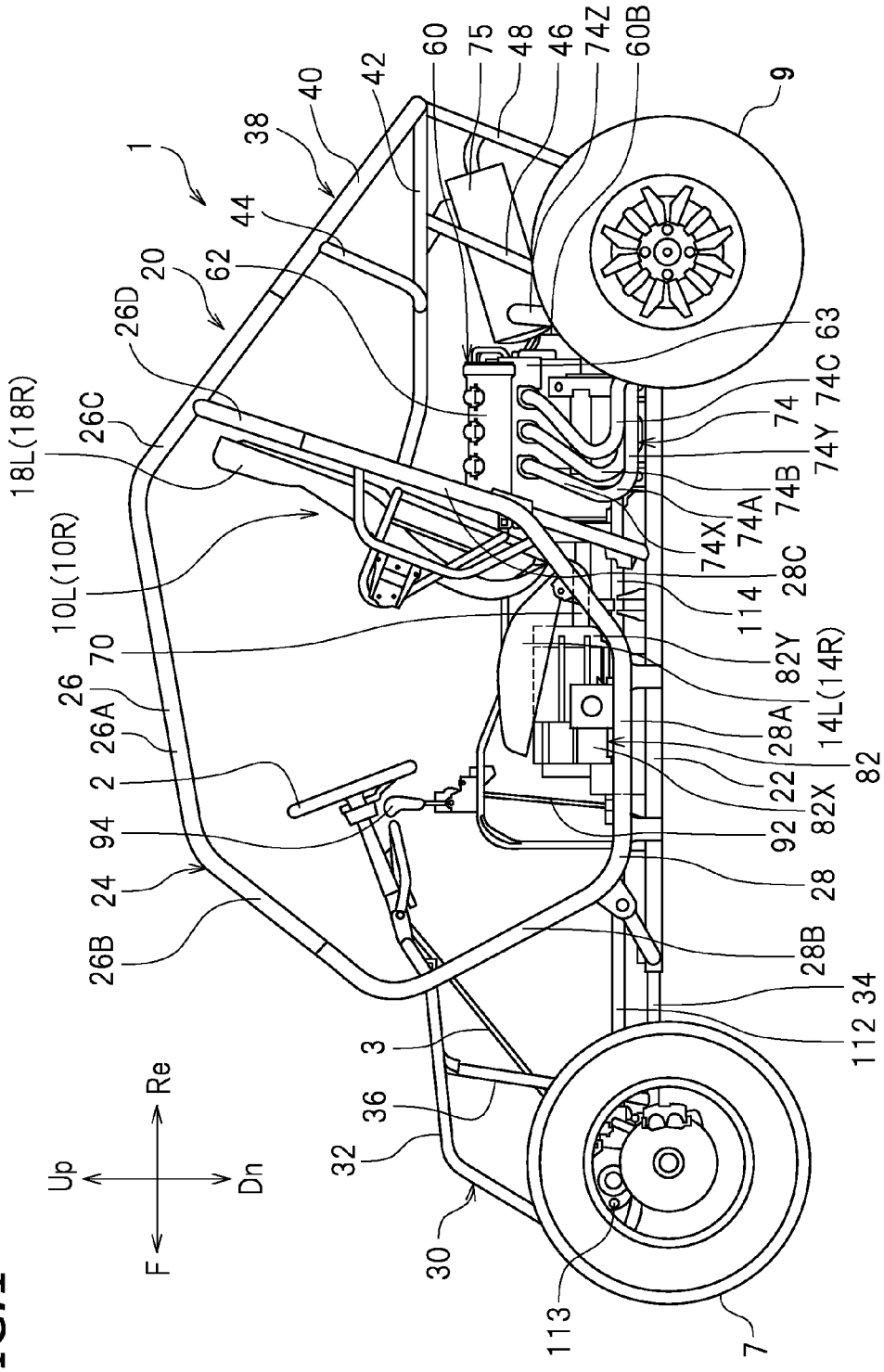

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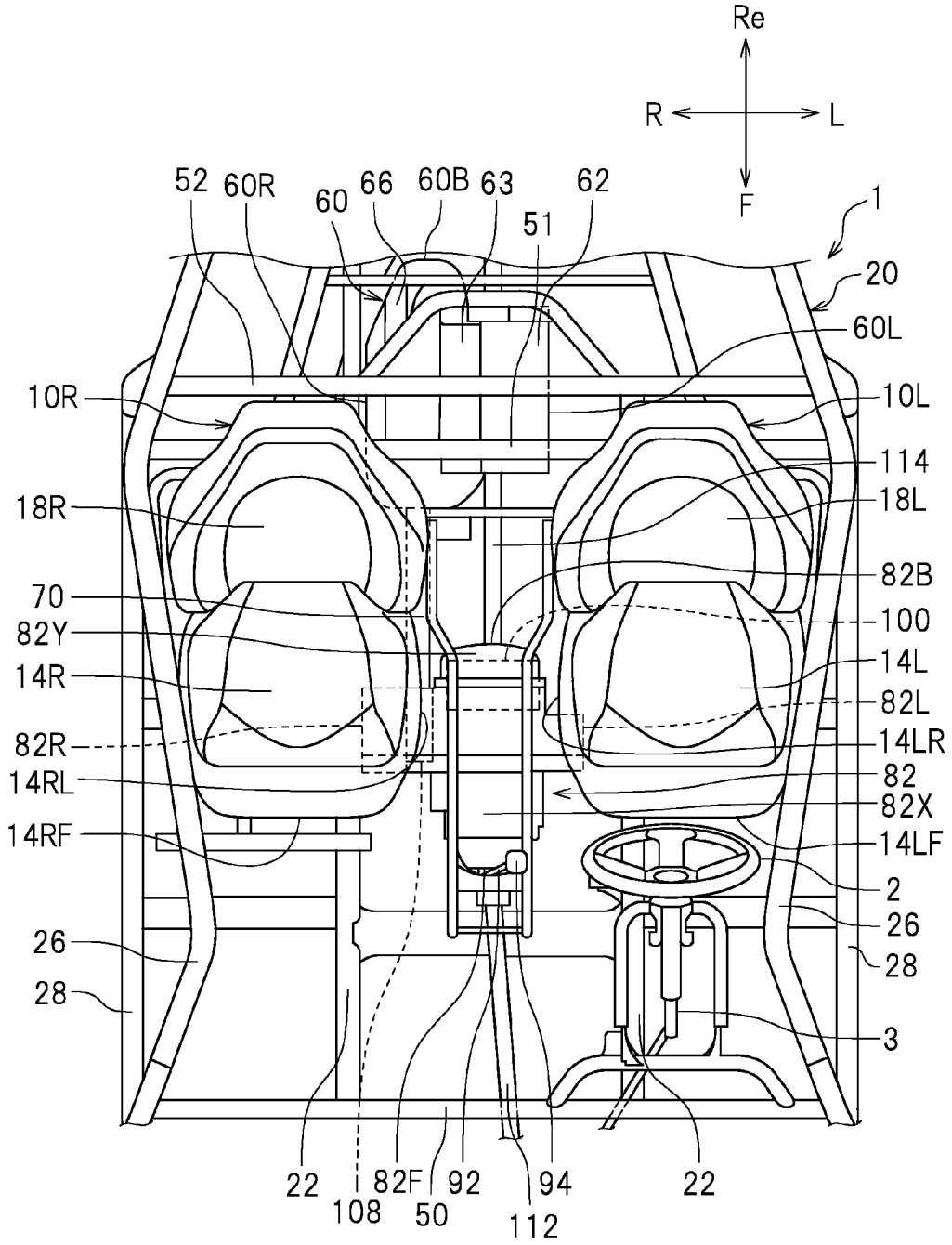
FIG. 1

FIG.2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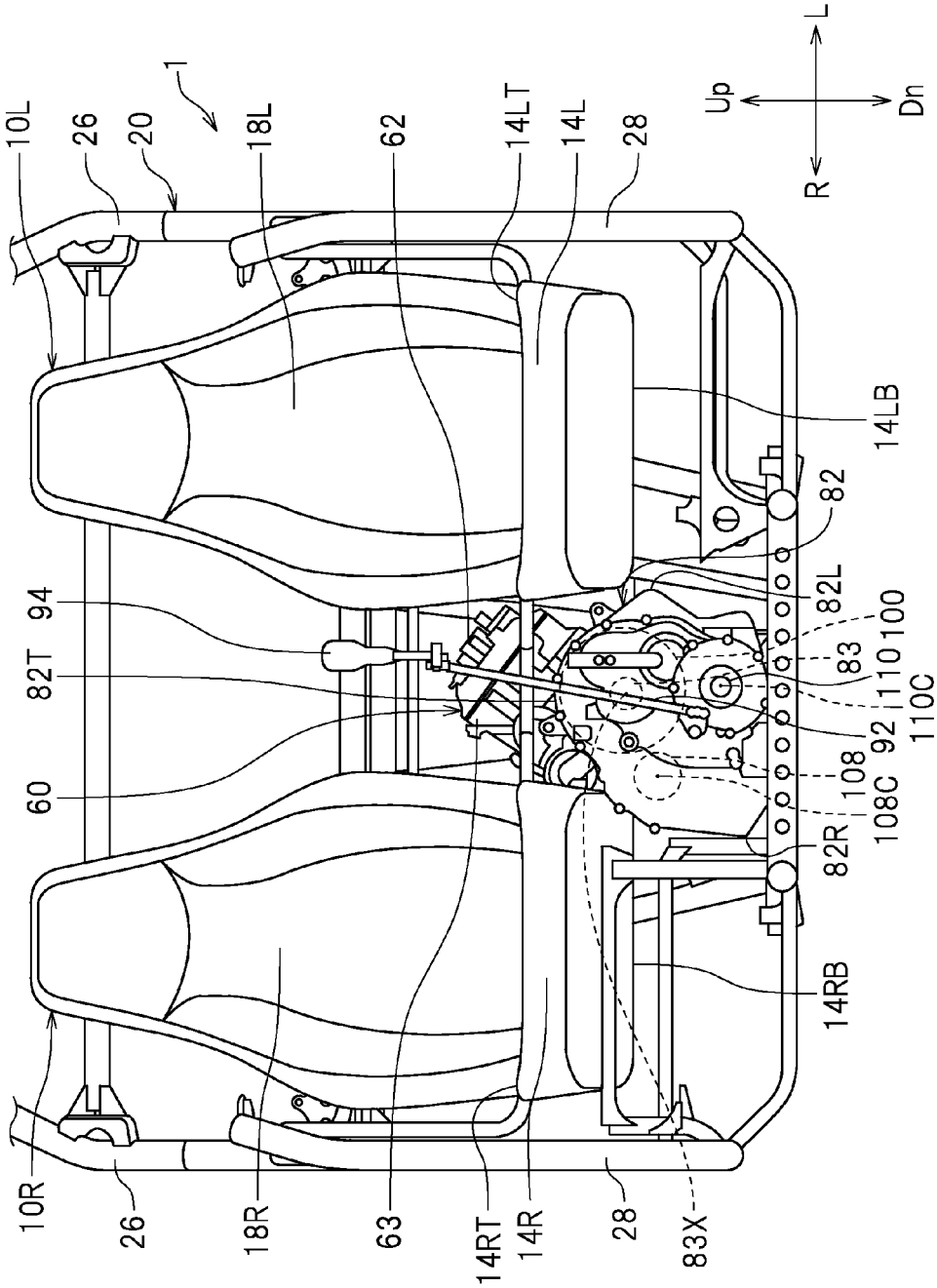
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110C
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108
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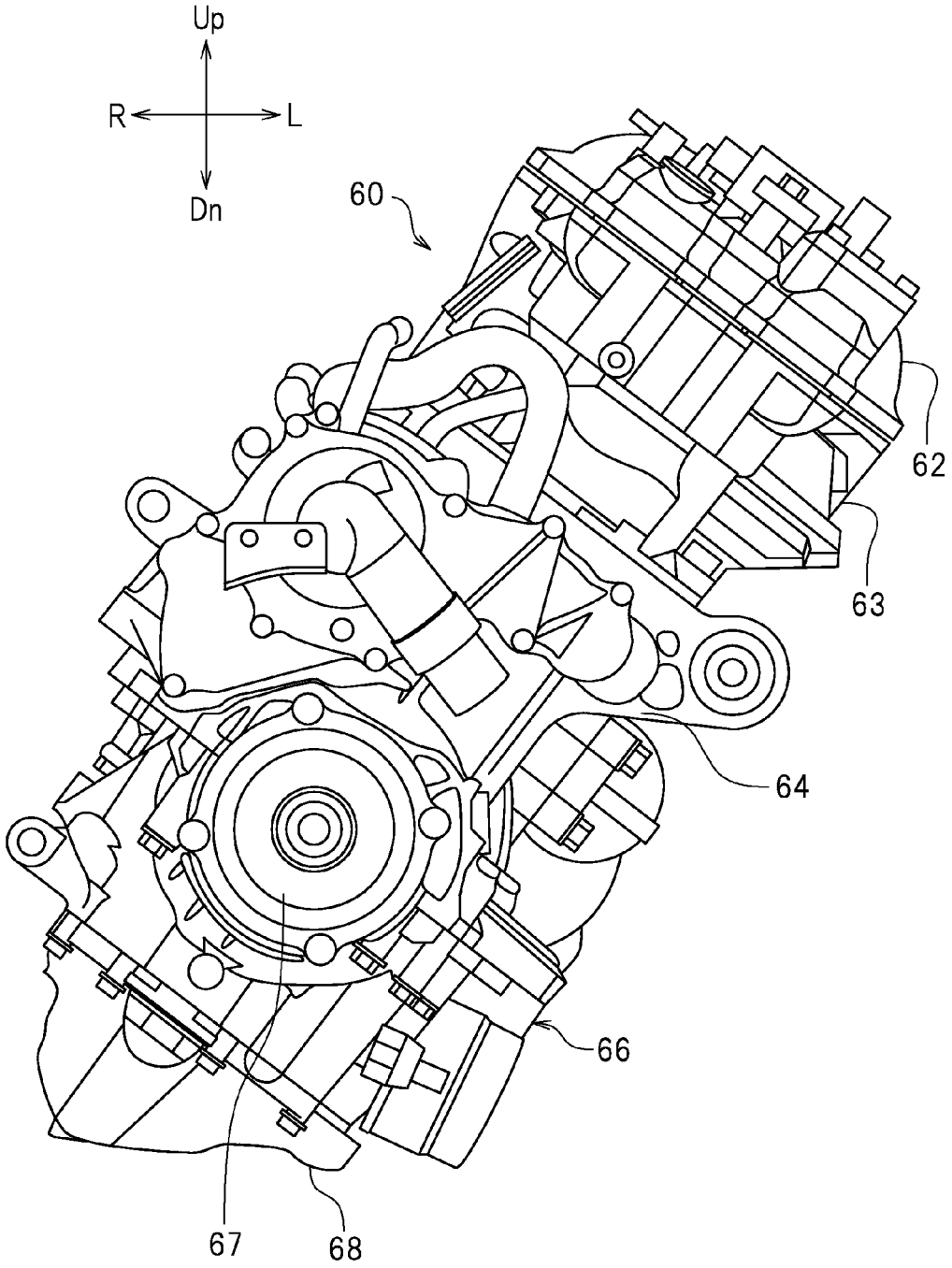
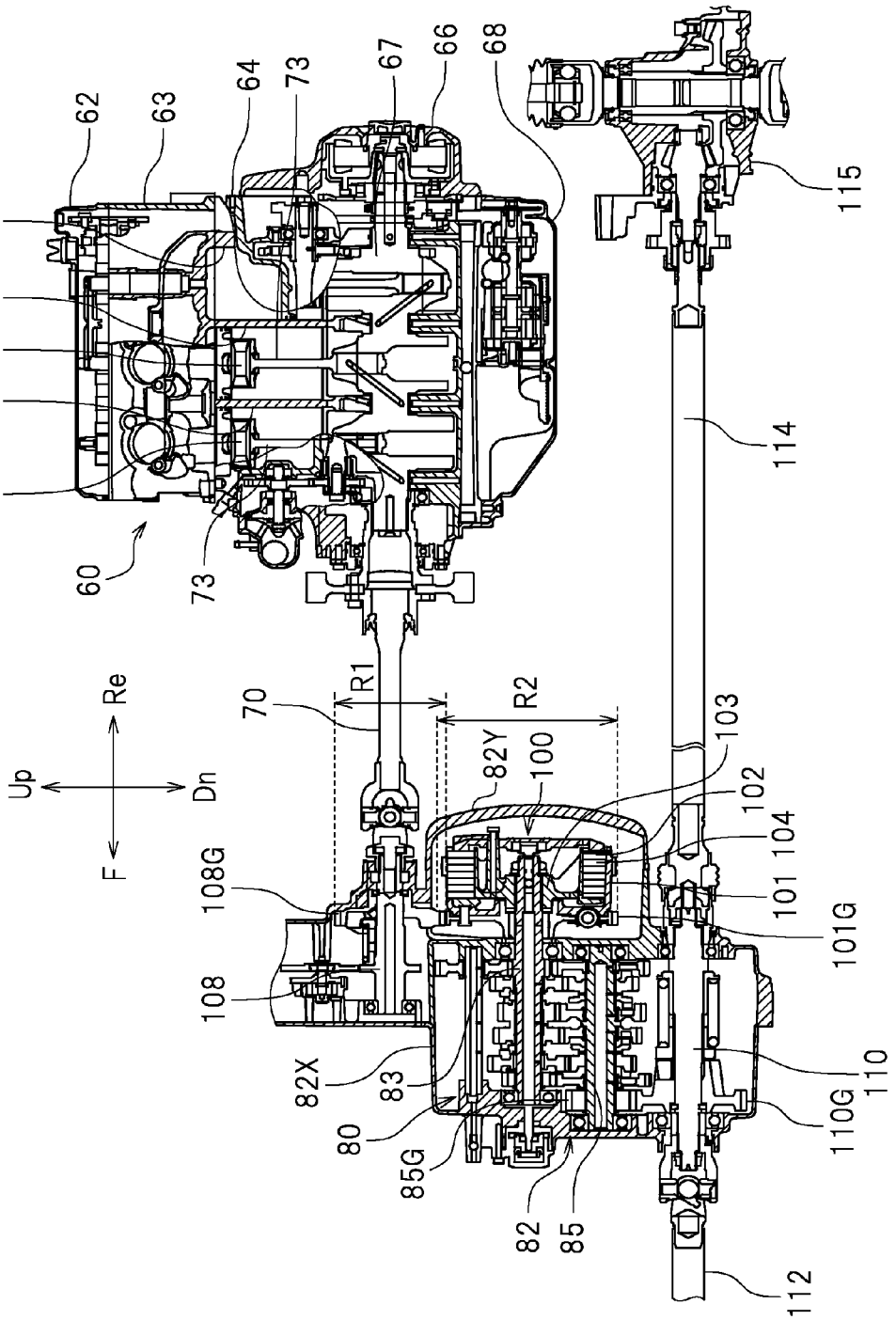
63
14RT
14R
28
83X

FIG.3

FIG.4

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R1
R2
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82Y
100
102
104
Up
Re
Dn
F
108G
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101G
108
82X
83
110
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85G
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85
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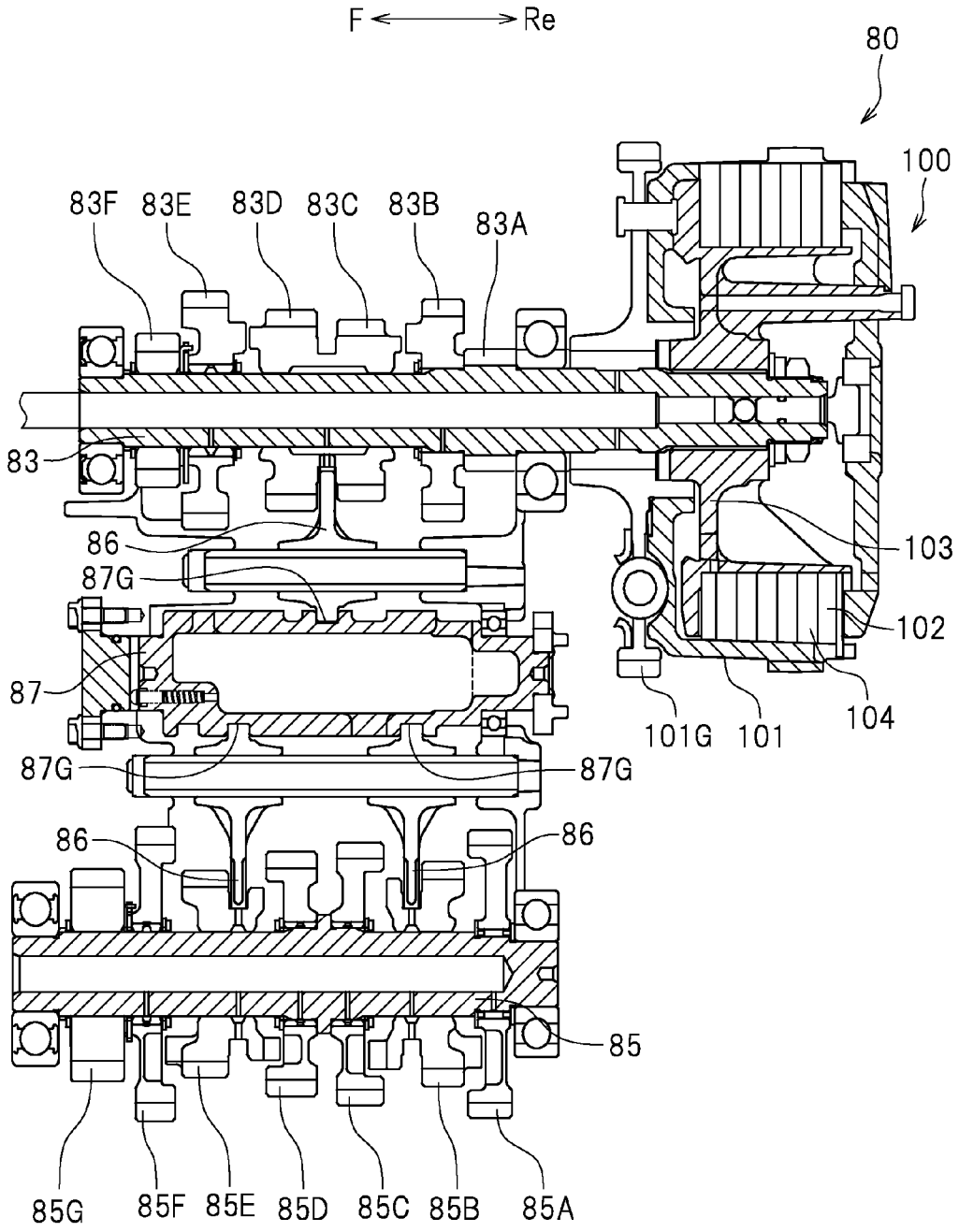
FIG.5

FIG.6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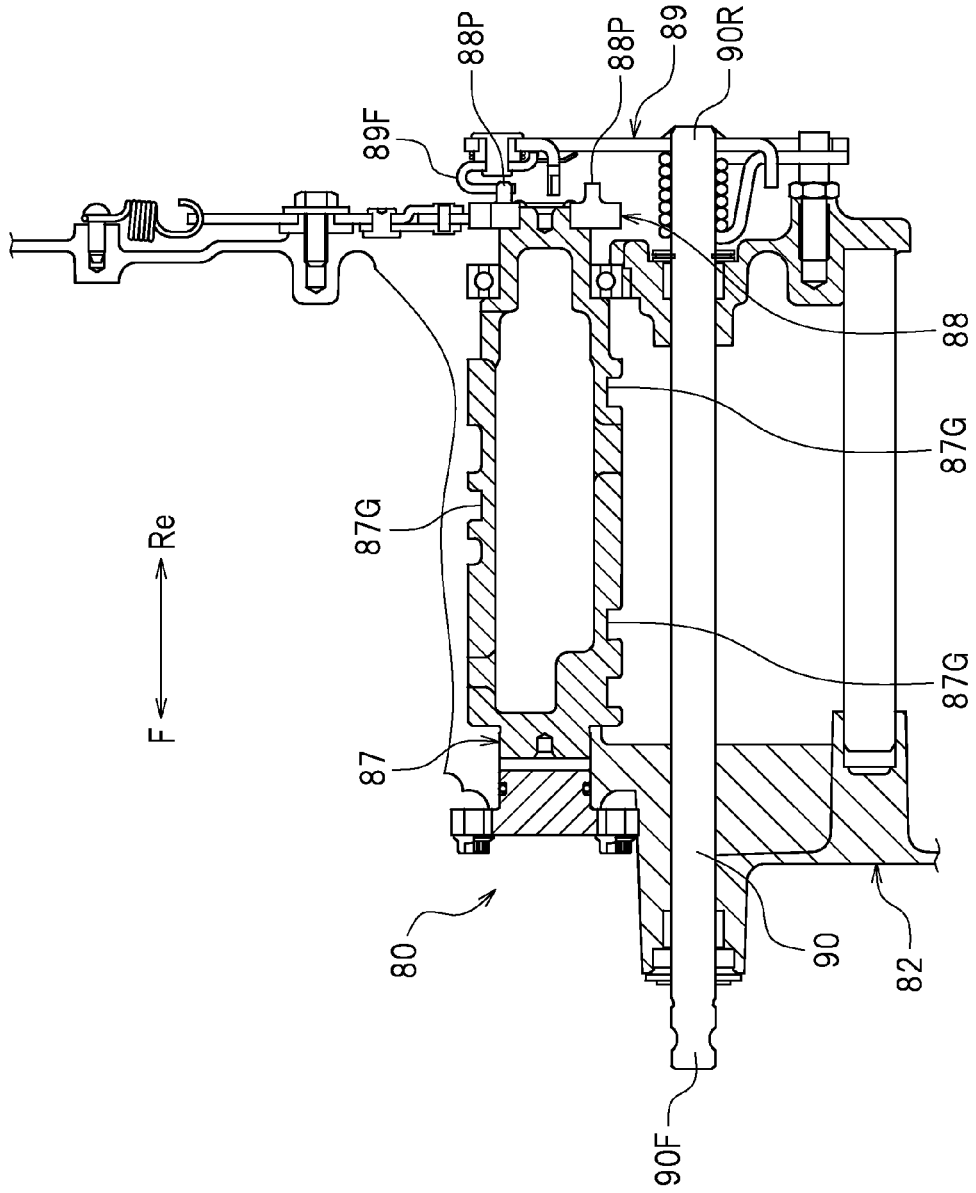


FIG.7

# VEHICLE

This application claims priority to Patent Application No. 2014-22207 filed in Japan on Feb. 7, 2014, the entire contents of which are hereby incorporated by reference.

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to vehicles suitable for traveling on rough terrain.

2. Description of the Related Art

As a vehicle suitable for traveling on rough terrain, a recreational off-highway vehicle (which will hereinafter be referred to as an "ROV") is conventionally known. U.S. Pat. No. 8,177,008 B2 discloses an ROV in which an engine is disposed below two seats arranged in a vehicle width direction. The ROV disclosed in U.S. Pat. No. 8,177,008 B2 includes a transmission case in which a continuously variable transmission (which will hereinafter be referred to as a "CVT") is provided. The transmission case is integral with the engine.

## SUMMARY OF THE INVENTION

Although a CVT is used in a conventional ROV, an ROV including a "stepped transmission" is desired from the viewpoint of further improving durability, for example. Since an ROV travels on rough terrain, there is also a demand for an increase in minimum road clearance of a bottom surface of the ROV. However, if a position of the bottom surface of the ROV according to U.S. Pat. No. 8,177,008 B2 which is measured from the ground is merely further raised, positions of the seats are raised. As a solution to such a problem, it is conceivable that the engine and the transmission case located below the seats may be disposed rearward relative to the seats, thus further lowering the positions of the seats. However, when an attempt is made to cause the engine and the transmission case to be disposed rearward relative to the seats, a large space has to be provided at a position rearward relative to the seats, which disadvantageously prevents components such as the engine from being compactly disposed and results in an increase in the size of the vehicle.

Accordingly, preferred embodiments of the present invention provide a vehicle in which positions of the seats are further lowered and flexibility of the layout of an engine and a transmission case is improved, thus preventing an increase in the size of the vehicle.

A vehicle according to a preferred embodiment of the present invention includes a body frame; a first seat including a first seating portion supported by the body frame and on which an occupant sits; a second seat including a second seating portion supported by the body frame and on which an occupant sits, the second seat being disposed rightward of the first seat; an engine including a crankshaft extending in a front-rear direction of the vehicle, the engine being supported by the body frame and disposed rearward relative to the first and second seating portions; a transmission configured to rotate by receiving a driving force from the crankshaft and including a main shaft provided with a plurality of first gears including a first axially movable gear, and a drive shaft provided with a plurality of second gears including a second axially movable gear and configured to intermesh with the first gears; and a transmission case provided as a component separate from the engine and spaced away from the engine and in which the transmission is contained. At least a portion of the transmission case is disposed between the first and second seating portions, and above a lower end of the first seating portion and a lower end of the second seating portion.



In the vehicle according to a preferred embodiment of the present invention, the engine is disposed rearward of the first and second seating portions. At least a portion of the transmission case spaced away from the engine is disposed between the first and second seating portions, and above the lower end of the first seating portion and the lower end of the second seating portion. Therefore, the first and second seating portions are disposed at lower positions than when the engine and the transmission case are disposed below the first and second seating portions. The engine and the transmission case are provided as separate components and spaced away from each other. Hence, the layout flexibility of each of the engine and the transmission case is improved compared to when the engine and the transmission case are integral with each other. More specifically, the engine and the transmission case are each disposed more compactly than when the engine and the transmission case are integral with each other, and as a result, an increase in the size of the vehicle is prevented.

According to a preferred embodiment of the present invention, the transmission preferably further includes an input shaft disposed coaxially with the crankshaft and configured to rotate by receiving a driving force from the crankshaft; and a clutch provided on the main shaft and to which a torque of the crankshaft is transmitted via the input shaft. The input shaft and the clutch preferably do not overlap with each other in a front view of the vehicle.

According to the above-described preferred embodiment, the clutch is replaced more easily than when the clutch is disposed coaxially with the crankshaft.

According to another preferred embodiment of the present invention, the transmission preferably further includes a third gear provided on the input shaft, and a fourth gear provided on the clutch and configured to intermesh with the third gear. A diameter of the third gear is preferably smaller than a diameter of the fourth gear.

According to the above-described preferred embodiment, a rotational frequency of the clutch is lower than a rotational frequency of the crankshaft due to the intermeshing of the third gear and the fourth gear. As a result, a load applied to the clutch is reduced, and the durability of the clutch is improved.

According to still another preferred embodiment of the present invention, the transmission preferably further includes an output shaft configured to rotate by receiving a driving force from the drive shaft. The output shaft preferably extends in the vehicle front-rear direction and is preferably connected to a propeller shaft configured to rotate by receiving a driving force from the output shaft. An axial center of the input shaft is preferably disposed below an axial center of the main shaft and above an axial center of the output shaft.

According to the above-described preferred embodiment, the clutch, which has a relatively large diameter. is compactly disposed inside the transmission case, while the input shaft and the output shaft are disposed at low positions.

According to yet another preferred embodiment of the present invention, the input shaft preferably overlaps with the first seat or the second seat in a plan view of the vehicle.

According to the above-described preferred embodiment, a distance between the first and second seats is reduced. Hence, the first and second seats are compactly disposed. As a result, a length of the vehicle in a width direction thereof is reduced.

According to still yet another preferred embodiment of the present invention, the clutch preferably is a multiplate wet clutch including a plurality of driving plates and a plurality of driven plates.

According to the above-described preferred embodiment, the clutch is a wet clutch and thus has high durability. Furthermore, the clutch is a multiplate clutch, and therefore, each plate is reduced in diameter while the performance of the clutch is ensured. As a result, the clutch is compactly disposed inside the transmission case.

According to another preferred embodiment of the present invention, the vehicle preferably further includes a shift fork configured to engage with the first and second movable gears; a shift drum provided with a groove with which the shift fork engages; a rotation plate fixed to one end of the shift drum and configured to rotate together with the shift drum; a shift lever that engages with the rotation plate; a shift shaft fixed to the shift lever and extending in the vehicle front-rear direction; a link member disposed in front of the transmission case and connected to the shift shaft; and a shift operation lever fixed to the link member and by which a transmission gear ratio of the transmission is changed. The clutch is preferably located rearward relative to the first and second movable gears.

According to the above-described preferred embodiment, a distance between the shift operation lever and the shift shaft is short, thus simplifying a structure of the link member. Furthermore, the link member is compactly disposed.

According to still another preferred embodiment of the present invention, the clutch is preferably disposed rightward relative to a right end of the first seating portion and leftward relative to a left end of the second seating portion.

According to the above-described preferred embodiment, the clutch is disposed between the first and second seating portions, and, therefore, the clutch is easily replaced.

According to yet another preferred embodiment of the present invention, the engine and the transmission case preferably overlap with each other in a front view of the vehicle.

According to the above-described preferred embodiment, the engine and the transmission case are disposed more compactly than when the engine and the transmission case are disposed so as to be deviated from each other in the front view of the vehicle.

According to still yet another preferred embodiment of the present invention, the engine preferably further includes a cylinder body including a plurality of cylinders arranged in the vehicle front-rear direction.

According to the above-described preferred embodiment, a length of the engine in the vehicle width direction is shorter than when the cylinders are arranged in the vehicle width direction. As a result, the engine is compactly disposed.

Various preferred embodiments of the present invention provide a vehicle in which positions of the seats are further lowered and flexibility of the layout of an engine and a transmission case is improved, thus preventing an increase in the size of the vehicle.

The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a left side view illustrating an ROV according to a preferred embodiment of the present invention.

FIG. **2** is a plan view illustrating the ROV according to a preferred embodiment of the present invention.

FIG. **3** is a front view illustrating a structure around the seats according to a preferred embodiment of the present invention.

FIG. **4** is a front view illustrating an engine according to a preferred embodiment of the present invention.

FIG. **5** is a cross-sectional view illustrating structures of the engine and a transmission according to a preferred embodiment of the present invention.

FIG. **6** is a cross-sectional view illustrating the transmission according to a preferred embodiment of the present invention.

FIG. **7** is a cross-sectional view illustrating a structure around a shift drum according to a preferred embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, preferred embodiments of the present invention will be described. As illustrated in FIG. **1**, a vehicle according to a preferred embodiment of the present invention is an ROV (recreational off-highway vehicle) **1**. The ROV **1** is suitable for traveling on rough terrain. Note that the vehicle according to the present invention is not limited to an ROV.

In the following description, unless otherwise noted, the terms "front", "rear", "right", "left", "up" and "down" refer to front, rear, right, left, up and down with respect to an occupant sitting on a seat portion **14**L of the ROV **1**, respectively. "Up" and "down" correspond to a vertically upward direction and a vertically downward direction when the ROV **1** is brought to a stop on a horizontal plane, respectively. Reference signs "F", "Re", "R", "L", "Up" and "Dn" in the drawings represent front, rear, right, left, up and down, respectively.

As illustrated in FIG. **1**, the ROV **1** preferably includes a body frame **20**. The body frame **20** is preferably made up of pipe-shaped members. The body frame **20** preferably includes a main frame **22** that extends in a front-rear direction of the vehicle; a center frame **24** disposed above the main frame **22**; a front frame **30** disposed in front of the center frame **24**; and a rear frame **38** disposed rearward of the center frame **24**.

The center frame **24** preferably includes right and left upper center frames **26** and right and left lower center frames **28**. The upper center frames **26** are disposed above the lower center frames **28**. Each upper center frame **26** is connected to the associated lower center frame **28**. Each upper center frame **26** preferably includes a first portion **26**A that extends in or substantially in the vehicle front-rear direction, a second portion **26**B that extends obliquely downward and frontward from a front end of the first portion **26**A, a third portion **26**C that extends obliquely downward and rearward from a rear end of the first portion **26**A; and a fourth portion **26**D that extends obliquely downward and frontward from a position located somewhere along the third portion **26**C. Each lower center frame **28** is disposed above the main frame **22**. Each lower center frame **28** is connected to the main frame **22**. Each lower center frame **28** preferably includes a first portion **28**A that extends in the vehicle front-rear direction, a second portion **28**B that extends obliquely upward and frontward from a front end of the first portion **28**A, and a third portion **28**C that extends obliquely upward and rearward from a rear end of the first portion **28**A. The first portion **28**A is connected to the main frame **22**. The second portion **28**B is connected to the second portion **26**B of the associated upper center frame **26**. The third portion **28**C is connected to the fourth portion **26**D of the associated upper center frame **26**.

As illustrated in FIG. **2**, the body frame **20** preferably further includes a first cross member **50**, a second cross member **51**, and a third cross member **52**. The first to third cross members **50** to **52** each extend in a width direction of the vehicle. The second cross member **51** is disposed rearward relative to the first cross member **50**. The third cross member

52 is disposed rearward relative to the second cross member 51. The right and left lower center frames 28 are connected to each other through the first and second cross members 50 and 51. The right and left upper center frames 26 are connected to each other through the third cross member 52.

As illustrated in FIG. 1, the front frame 30 preferably includes an upper front frame 32, a lower front frame 34, and a front down frame 36. The upper front frame 32 is connected to the first cross member 50 (see FIG. 2). The upper front frame 32 extends frontward from the first cross member 50. The front down frame 36 extends downward from a position located somewhere along the upper front frame 32. The front down frame 36 is connected to a position located somewhere along the lower front frame 34. The lower front frame 34 extends in the vehicle front-rear direction. A front end of the lower front frame 34 is connected to the upper front frame 32. A rear end of the lower front frame 34 is connected to the main frame 22.

The rear frame 38 preferably includes right and left upper rear frames 40, right and left lower rear frames 42, right and left first rear down frames 44, right and left second rear down frames 46, and right and left third rear down frames 48. Each upper rear frame 40 extends obliquely downward and rearward from the third portion 26C of the associated upper center frame 26. Each lower rear frame 42 extends rearward from a position located somewhere along the third portion 28C of the associated lower center frame 28. Rear ends of the upper rear frames 40 and rear ends of the lower rear frames 42 are connected to each other. Each first rear down frame 44 extends obliquely downward and frontward from a position located somewhere along the associated upper rear frame 40. Each first rear down frame 44 is connected to a position located somewhere along the associated lower rear frame 42. Each second rear down frame 46 extends obliquely downward and frontward from a position located somewhere along the associated lower rear frame 42. Each second rear down frame 46 is disposed rearward relative to the associated first rear down frame 44. Each third rear down frame 48 extends obliquely downward and frontward from the rear end of the associated lower rear frame 42. Each third rear down frame 48 is disposed rearward relative to the associated second rear down frame 46.

As illustrated in FIG. 2, the ROV 1 preferably further includes a steering wheel 2. A steering shaft 3 is attached to the steering wheel 2. As illustrated in FIG. 1, the ROV 1 preferably further includes right and left front wheels 7, and right and left rear wheels 9. The right and left front wheels 7 are attached to an axle (not illustrated) which is provided at the front frame 30. The right and left rear wheels 9 are attached to an axle (not illustrated) which is provided at the rear frame 38. The right and left front wheels 7 are steered by the steering wheel 2.

As illustrated in FIG. 2, a right seat 10R and a left seat 10L are disposed rearward relative to the steering wheel 2. The left seat 10L is supported by the body frame 20. More specifically, the left seat 10L is supported by the main frame 22. The right seat 10R is supported by the body frame 20. More specifically, the right seat 10R is supported by the main frame 22. The left seat 10L is disposed behind the steering wheel 2. The right seat 10R is disposed rightward of the left seat 10L. The left seat 10L preferably includes the seating portion 14L on which an occupant sits, and a backrest portion 18L. As illustrated in FIG. 1, the seating portion 14L is disposed above the first portion 28A of the associated lower center frame 28. The backrest portion 18L is disposed frontward relative to the fourth portion 26D of the associated upper center frame 26. The backrest portion 18L is disposed frontward relative to the third portion 28C of the associated lower center frame 28. As illustrated in FIG. 3, the right seat 10R preferably includes a seating portion 14R on which an occupant sits, and a backrest portion 18R. As illustrated in FIG. 1, the seating portion 14R is disposed above the first portion 28A of the associated lower center frame 28. The backrest portion 18R is disposed frontward relative to the fourth portion 26D of the associated upper center frame 26. The backrest portion 18R is disposed frontward relative to the third portion 28C of the associated lower center frame 28.

The ROV 1 further includes an engine 60. The engine 60 is supported by the body frame 20. More specifically, the engine 60 is supported by the main frame 22. As illustrated in FIG. 2, the engine 60 is disposed rearward relative to the seating portion 14L of the left seat 10L and the seating portion 14R of the right seat 10R. As illustrated in FIG. 1, the engine 60 is disposed below the lower rear frames 42. A rear end 60B of the engine 60 is located rearward relative to the backrest portions 18R and 18L. The rear end 60B of the engine 60 is located rearward relative to the lower center frames 28. As illustrated in FIG. 2, a left end 60L of the engine 60 is located rightward relative to a right end 14LR of the seating portion 14L. A right end 60R of the engine 60 is located rightward relative to a left end 14RL of the seating portion 14R. A portion of the engine 60 overlaps with the right seat 10R in a plan view of the vehicle. More specifically, a crankcase 66 of the engine 60 overlaps with the backrest portion 18R of the right seat 10R in the plan view of the vehicle.

As illustrated in FIG. 4, the engine 60 preferably includes the crankcase 66, a cylinder body 64, a cylinder head 63, and a cylinder head cover 62. An oil pan 68 is disposed under the crankcase 66. The oil pan 68 collects oil that has flowed through the engine 60. The cylinder body 64 extends upward from the crankcase 66. The cylinder head 63 is disposed on the cylinder body 64 and connected to an upper portion of the cylinder body 64. The cylinder head cover 62 is disposed on the cylinder head 63 and connected to an upper portion of the cylinder head 63.

As illustrated in FIG. 5, the engine 60 preferably further includes a crankshaft 67 that extends in the vehicle front-rear direction. The crankshaft 67 is disposed inside the crankcase 66. A connecting shaft 70 is connected to a front end portion of the crankshaft 67. The connecting shaft 70 is connected to an input shaft 108 which will be described below. As illustrated in FIG. 2, the connecting shaft 70 overlaps with the right seat 10R in the plan view of the vehicle. More specifically, the connecting shaft 70 overlaps with the seating portion 14R and the backrest portion 18R in the plan view of the vehicle. Alternatively, the connecting shaft 70 may be disposed so that the connecting shaft 70 overlaps with the left seat 10L in the plan view of the vehicle.

As illustrated in FIG. 5, a first cylinder 71A, a second cylinder 71B, and a third cylinder 71C are provided inside the cylinder body 64. The first, second, and third cylinders 71A, 71B and 71C extend upward from a lateral portion of the crankcase 66. The first, second, and third cylinders 71A, 71B, and 71C are arranged in the vehicle front-rear direction. The second cylinder 71B is disposed rearward of the first cylinder 71A. The third cylinder 71C is disposed rearward of the second cylinder 71B. The engine 60 is preferably a three cylinder engine, for example. A piston 72 is contained in each of the first, second, and third cylinders 71A, 71B, and 71C. Each piston 72 is connected to the crankshaft 67 via an associated connecting rod 73. Although the engine 60 according to the present preferred embodiment preferably is a three cylinder engine provided with three cylinders, i.e., the first to third cylinders 71A to 71C, the engine according to preferred

embodiments of the present invention may be a single cylinder engine provided with a single cylinder or may be a multi-cylinder engine provided with two cylinders or four or more cylinders.

As illustrated in FIG. **1**, the ROV **1** preferably further includes an exhaust pipe **74** through which exhaust gas discharged from the engine **60** flows, and a silencer **75**. The exhaust pipe **74** is connected to the engine **60**. The exhaust pipe **74** preferably includes a first exhaust pipe **74**A in communication with the first cylinder **71**A, a second exhaust pipe **74**B in communication with the second cylinder **71**B, and a third exhaust pipe **74**C in communication with the third cylinder **71**C. Each of the first to third exhaust pipes **74**A to **74**C preferably includes a first portion **74**X that extends obliquely downward and frontward from the cylinder head **63**, and a second portion **74**Y that extends rearward from the first portion **74**X. At rear ends of the second portions **74**Y, the first to third exhaust pipes **74**A to **74**C are combined into a single pipe defining a third portion **74**Z. The silencer **75** is connected to a rear end of the third portion **74**Z. Note that the exhaust pipe **74** and the silencer **75** are not illustrated in FIGS. **2** and **3** for the sake of convenience.

As illustrated in FIG. **1**, the ROV **1** further includes a transmission **80** (see FIG. **5**), and a transmission case **82** in which the transmission **80** is contained. The transmission case **82** preferably includes a case main body **82**X and a case cover **82**Y. The transmission case **82** and the engine **60** are provided as separate components. The transmission case **82** is spaced away from the engine **60**. The transmission case **82** is disposed frontward relative to the engine **60**. The transmission case **82** is attached to the main frame **22**. As illustrated in FIG. **3**, the engine **60** and the transmission case **82** overlap with each other in a front view of the vehicle. However, the cylinder head cover **62** and the transmission case **82** do not overlap with each other in the front view of the vehicle.

As illustrated in FIG. **2**, at least a portion of the transmission case **82** is disposed between the seating portion **14**L of the left seat **10**L and the seating portion **14**R of the right seat **10**R. As illustrated in FIG. **3**, at least a portion of the transmission case **82** is disposed above a lower end **14**LB of the seating portion **14**L of the left seat **10**L. More specifically, an upper end **82**T of the transmission case **82** is disposed above the lower end **14**LB of the seating portion **14**L. The upper end **82**T of the transmission case **82** is disposed below an upper end **14**LT of the seating portion **14**L. At least a portion of the transmission case **82** is disposed above a lower end **14**RB of the seating portion **14**R of the right seat **10**R. More specifically, the upper end **82**T of the transmission case **82** is disposed above the lower end **14**RB of the seating portion **14**R. The upper end **82**T of the transmission case **82** is disposed below an upper end **14**RT of the seating portion **14**R. As illustrated in FIG. **2**, a portion of the transmission case **82** overlaps with the seating portion **14**L in the plan view of the vehicle. A left end **82**L of the transmission case **82** is located leftward relative to the right end **14**LR of the seating portion **14**L. A portion of the transmission case **82** overlaps with the seating portion **14**R in the plan view of the vehicle. Aright end **82**R of the transmission case **82** is located rightward relative to the left end **14**RL of the seating portion **14**R. A rear end **82**B of the transmission case **82** is located rearward relative to a front end **14**RF of the seating portion **14**R and a front end **14**LF of the seating portion **14**L. A front end **82**F of the transmission case **82** is located frontward relative to the front end **14**RF of the seating portion **14**R and the front end **14**LF of the seating portion **14**L.

As illustrated in FIG. **5**, the transmission **80** preferably includes the input shaft **108**, a clutch **100**, a main shaft **83**, a drive shaft **85**, and an output shaft **110**.

The input shaft **108** extends in the vehicle front-rear direction. The input shaft **108** is contained inside the transmission case **82**. The input shaft **108** is disposed coaxially with the crankshaft **67**. An axial center **108**C (see FIG. **3**) of the input shaft **108** may be different from an axial center (not illustrated) of the crankshaft **67**. The input shaft **108** is connected to the connecting shaft **70**. The input shaft **108** rotates by receiving a driving force from the crankshaft **67**. The input shaft **108** is provided with a gear **108**G. As illustrated in FIG. **3**, the axial center **108**C of the input shaft **108** is disposed below an axial center **83**X of the main shaft **83** which will be described below. The axial center **108**C of the input shaft **108** is disposed above an axial center **110**C of the output shaft **110** which will be described below. The input shaft **108** is disposed rightward relative to the main shaft **83**. The input shaft **108** is disposed rightward relative to the output shaft **110**. As illustrated in FIG. **2**, the input shaft **108** is located rightward relative to the clutch **100**. The input shaft **108** overlaps with the right seat **10**R in the plan view of the vehicle. More specifically, the input shaft **108** overlaps with the seating portion **14**R in the plan view of the vehicle. Alternatively, the input shaft **108** may be located leftward relative to the clutch **100**. In that case, the input shaft **108** may overlap with the left seat **10**L in the plan view of the vehicle, and more specifically, the input shaft **108** may overlap with the seating portion **14**L in the plan view of the vehicle. As illustrated in FIG. **5**, the input shaft **108** is connected to the crankshaft **67** via the connecting shaft **70** in the present preferred embodiment, but the input shaft **108** may be directly connected to the crankshaft **67**.

The clutch **100** is preferably a multiplate wet friction clutch. A torque produced by the crankshaft **67** is transmitted to the clutch **100** via the input shaft **108**. The clutch **100** transmits or interrupts the torque produced by the crankshaft **67**. The clutch **100** is disposed inside the transmission case **82**. The clutch **100** is exposed to the outside by detaching the case cover **82**Y of the transmission case **82** from the case main body **82**X. The clutch **100** is provided at a rear end portion of the main shaft **83**. As illustrated in FIG. **6**, the clutch **100** is located rearward of main shaft gears **83**A to **83**F of the main shaft **83** which will be described below. The clutch **100** is located rearward of drive shaft gears **85**A to **85**F of the drive shaft **85** which will be described below. As illustrated in FIG. **2**, the clutch **100** is disposed between the right and left seats **10**R and **10**L. The clutch **100** is disposed rightward of the right end **14**LR of the seating portion **14**L. The clutch **100** is disposed leftward of the left end **14**RL of the seating portion **14**R. As illustrated in FIG. **3**, the clutch **100** and the input shaft **108** do not overlap with each other in the front view of the vehicle. As illustrated in FIG. **6**, the clutch **100** preferably includes a clutch housing **101**, a clutch boss **103**, a plurality of driving plates **102**, and a plurality of driven plates **104**. The driving plates **102** are provided inward of the clutch housing **101**. The driving plates **102** rotate together with the clutch housing **101**. The torque of the crankshaft **67** (see FIG. **5**) is transmitted to the driving plates **102**. The driven plates **104** are arranged outward of the clutch boss **103**. The driven plates **104** rotate together with the clutch boss **103**. The driving plates **102** and the driven plates **104** are alternately disposed in the vehicle front-rear direction. The clutch housing **101** is provided with a gear **101**G. As illustrated in FIG. **5**, the gear **101**G intermeshes with the gear **108**G of the input shaft **108**. Therefore, the clutch housing **101** is connected to the input shaft **108**. A diameter R1 of the gear **108**G is smaller than a

diameter R2 of the gear 101G. The clutch 100 may be a single plate friction clutch. The clutch 100 may be a dry friction clutch.

The main shaft 83 extends in the vehicle front-rear direction. The main shaft 83 is contained inside the transmission case 82. The main shaft 83 is disposed parallel or substantially parallel with the input shaft 108. The main shaft 83 is fixed to the clutch boss 103. The main shaft 83 rotates together with the clutch boss 103. The main shaft 83 rotates by receiving a driving force from the crankshaft 67. As illustrated in FIG. 6, the main shaft 83 is provided with the main shaft gears 83A to 83F. The main shaft gears 83A, 83B, 83E, and 83F are fixed gears which are immovable in an axial direction of the main shaft 83. The main shaft gears 83C and 83D are movable gears which are movable in the axial direction of the main shaft 83. The main shaft gears 83A to 83F rotate together with the main shaft 83. The main shaft gears 83B and 83E relatively rotate with respect to the main shaft 83 depending on the intermeshing states of the main shaft gears 83B and 83E. As illustrated in FIG. 3, the axial center 83X of the main shaft 83 is located above the lower end 14LB of the seating portion 14L and the lower end 14RB of the seating portion 14R. The axial center 83X of the main shaft 83 is located rightward relative to the axial center 110C of the output shaft 110 which will be described below.

As illustrated in FIG. 5, the drive shaft 85 extends in the vehicle front-rear direction. The drive shaft 85 is contained inside the transmission case 82. The drive shaft 85 is disposed parallel or substantially parallel with the main shaft 83. As illustrated in FIG. 6, the drive shaft 85 is provided with the drive shaft gears 85A to 85F. The drive shaft gears 85A to 85F are arranged so that the drive shaft gears 85A to 85F intermesh with the main shaft gears 83A to 83F, respectively. The drive shaft gears 85A, 85C, 85D, and 85F are fixed gears which are immovable in an axial direction of the drive shaft 85. The drive shaft gears 85B and 85E are movable gears which are movable in the axial direction of the drive shaft 85. The drive shaft gears 85A to 85F rotate together with the drive shaft 85. The drive shaft gears 85A, 85C, 85D, and 85F relatively rotate with respect to the drive shaft 85 depending on intermeshing states of the drive shaft gears 85A, 85C, 85D, and 85F. A front end portion of the drive shaft 85 is provided with a gear 85G. The gear 85G is disposed frontward relative to the drive shaft gear 85F.

As illustrated in FIG. 5, the output shaft 110 extends in the vehicle front-rear direction. The output shaft 110 is contained inside the transmission case 82. The output shaft 110 is provided with a gear 110G. The gear 110G intermeshes with the gear 85G of the drive shaft 85. Therefore, the output shaft 110 is connected to the drive shaft 85. The output shaft 110 rotates by receiving a driving force from the drive shaft 85. A front propeller shaft 112 is connected to a front end portion of the output shaft 110. The front propeller shaft 112 extends in the vehicle front-rear direction. The front propeller shaft 112 rotates by receiving a driving force from the output shaft 110. The front propeller shaft 112 is connected to the right and left front wheels 7 (see FIG. 1) via a front differential 113 (see FIG. 1). A rear propeller shaft 114 is connected to a rear end portion of the output shaft 110. The rear propeller shaft 114 extends in the vehicle front-rear direction. The rear propeller shaft 114 rotates by receiving a driving force from the output shaft 110. The rear propeller shaft 114 is connected to the right and left rear wheels 9 (see FIG. 1) via a final gear 115. Although the ROV according to the present preferred embodiment is a four-wheel drive vehicle, the vehicle according to other preferred embodiments of the present invention is not limited to a four-wheel drive vehicle.

As illustrated in FIG. 6, the transmission 80 preferably further includes a shift drum 87 and shift forks 86. The shift drum 87 is provided with a plurality of grooves 87G with axial positions that change in accordance with an angle of rotation of the shift drum 87. Each shift fork 86 is engaged with the associated groove 87G. The shift forks 86 are engaged with the main shaft gears 83C and 83D and the drive shaft gears 85B and 85E. Upon rotation of the shift drum 87, the shift forks 86 move in an axial direction of the shift drum 87. Then, the shift forks 86 move at least one of the main shaft gears 83C and 83D and the drive shaft gears 85B and 85E. As a result, a combination of the main shaft gear of the main shaft 83 and the drive shaft gear of the drive shaft 85 which intermesh with each other is changed, thus changing a transmission gear ratio.

As illustrated in FIG. 7, the transmission 80 preferably further includes a shift shaft 90. The shift shaft 90 extends in the vehicle front-rear direction. The shift shaft 90 is arranged so as to be rotatable. The shift shaft 90 is supported by the transmission case 82. A shift lever 89 which will be described below is fixed to a rear end portion 90R of the shift shaft 90. A front end portion 90F of the shift shaft 90 is located outward of the transmission case 82. The front end portion 90F of the shift shaft 90 is connected to a link member 92 (see FIG. 1). As illustrated in FIG. 1, a shift operation lever 94 by which the transmission gear ratio of the transmission 80 is changed is fixed to an upper portion of the link member 92. The link member 92 is disposed in front of the transmission case 82.

As illustrated in FIG. 7, the transmission 80 preferably further includes a rotation plate 88 and the shift lever 89. The rotation plate 88 preferably includes a plurality of pins 88P. The rotation plate 88 is fixed to a rear end of the shift drum 87. The rotation plate 88 rotates together with the shift drum 87. The shift lever 89 is engaged with the rotation plate 88. The shift lever 89 is provided with a hook 89F that is engageable with the pin(s) 88P of the rotation plate 88.

When the shift operation lever 94 (see FIG. 1) is operated by the occupant, the shift shaft 90 rotates and thus the shift lever 89 rotates. In this case, the hook 89F of the shift lever 89 and the pin(s) 88P of the rotation plate 88 engage with each other, thus causing the shift drum 87 to rotate together with the rotation plate 88. As a result, the transmission gear ratio is changed.

In the ROV 1, as illustrated in FIGS. 2 and 3, the engine 60 is disposed rearward relative to the seating portions 14R and 14L as described above. At least a portion of the transmission case 82 spaced away from the engine 60 is disposed between the seating portions 14R and 14L, and above the lower end 14LB of the seating portion 14L and the lower end 14RB of the seating portion 14R. Therefore, the seating portions 14R and 14L are disposed at lower positions than when the engine 60 and the transmission case 82 are disposed below the seating portions 14R and 14L. The engine 60 and the transmission case 82 are provided as separate components and spaced away from each other. Hence, the layout flexibility of each of the engine 60 and the transmission case 82 is improved compared to when the engine 60 and the transmission case 82 are integral with each other. More specifically, the engine 60 and the transmission case 82 are each disposed more compactly than when the engine 60 and the transmission case 82 are integral with each other, and as a result, an increase in the size of the ROV 1 is prevented.

In the ROV 1 according to the present preferred embodiment, the input shaft 108 and the clutch 100 do not overlap with each other in the front view of the vehicle. As a result, the clutch 100 is replaced more easily than when the clutch 100 is disposed coaxially with the crankshaft 67.

In the ROV **1** according to the present preferred embodiment, as illustrated in FIG. **5**, the diameter R**1** of the gear **108**G of the input shaft **108** is smaller than the diameter R**2** of the gear **101**G of the clutch **100**. Thus, a rotational frequency of the clutch **100** is lower than a rotational frequency of the crankshaft **67** due to the intermeshing of the gear **108**G and the gear **101**G. As a result, a load applied to the clutch **100** is reduced, and durability of the clutch **100** is improved.

In the ROV **1** according to the present preferred embodiment, as illustrated in FIG. **3**, the axial center **108**C of the input shaft **108** is disposed below the axial center **83**X of the main shaft **83** and above the axial center **110**C of the output shaft **110**. Consequently, the clutch **100**, which has a relatively large diameter, is compactly disposed inside the transmission case **82**, while the input shaft **108** and the output shaft **110** are disposed at low positions.

In the ROV **1** according to the present preferred embodiment, as illustrated in FIG. **2**, the input shaft **108** overlaps with the seat **10**R in the plan view of the vehicle. Thus, a distance between the seats **10**R and **10**L is reduced. Hence, the seats **10**R and **10**L are compactly disposed. As a result, a length of the ROV **1** in the vehicle width direction is reduced.

In the ROV **1** according to the present preferred embodiment, as illustrated in FIG. **6**, the clutch **100** is preferably a wet clutch and thus has a high durability. Furthermore, the clutch **100** is preferably a multiplate clutch including a plurality of the driving plates **102** and a plurality of the driven plates **104**, and therefore, the plates **102** and **104** are reduced in diameter while the performance of the clutch **100** is ensured. As a result, the clutch **100** is compactly disposed inside the transmission case **82**.

In the ROV **1** according to the present preferred embodiment, as illustrated in FIG. **1**, the link member **92** connected to the shift shaft **90** is disposed in front of the transmission case **82**, and the shift operation lever **94** is fixed to the link member **92**. As illustrated in FIG. **6**, the clutch **100** is located rearward relative to the main shaft gears **83**A to **83**F and the drive shaft gears **85**A to **85**F. As a result, a distance between the shift operation lever **94** and the shift shaft **90** is short, thus simplifying a structure of the link member **92**. Furthermore, the link member **92** is compactly disposed.

In the ROV **1** according to the present preferred embodiment, as illustrated in FIG. **2**, the clutch **100** is disposed rightward relative to the right end **14**LR of the seating portion **14**L and leftward relative to the left end **14**RL of the seating portion **14**R. Moreover, a space is provided between the transmission case **82** and the engine **60**. As a result, the clutch **100** is easily replaced.

In the ROV **1** according to the present preferred embodiment, as illustrated in FIG. **3**, the engine **60** and the transmission case **82** overlap with each other in the front view of the vehicle. As a result, the engine **60** and the transmission case **82** are disposed more compactly than when the engine **60** and the transmission case **82** are disposed so as to be deviated from each other in the front view of the vehicle.

In the ROV **1** according to the present preferred embodiment, as illustrated in FIG. **5**, the engine **60** preferably includes the cylinder body **64** that includes a plurality of cylinders, i.e., the cylinders **71**A, **71**B, and **71**C, which are arranged in the vehicle front-rear direction. Therefore, a length of the engine **60** in the vehicle width direction is shorter than when the cylinders **71**A, **71**B, and **71**C are arranged in the vehicle width direction. As a result, the engine **60** is compactly disposed.

In the foregoing preferred embodiments, the transmission **80** is preferably a manual transmission that changes gears in accordance with an operation performed by the occupant, but the transmission according to another preferred embodiment of the present invention is not limited to such a manual transmission. For example, the transmission may be an automatic transmission that automatically changes gears of the transmission by a motor in accordance with an operating state of the vehicle, irrespective of an intention of the driver. Alternatively, the transmission may be an automated manual transmission that changes gears of the transmission by a motor that is driven in accordance with an operation performed by the driver.

Although the clutch **100** is located rearward relative to the main shaft gears **83**A to **83**F of the main shaft **83** and the drive shaft gears **85**A to **85**F of the drive shaft **85** in the foregoing preferred embodiments, the location of the clutch **100** is not limited to such a location. Alternatively, the clutch **100** may be located frontward relative to the main shaft gears **83**A to **83**F and the drive shaft gears **85**A to **85**F.

The terms and expressions used herein are used for explanation purposes and should not be construed as being restrictive. It should be appreciated that the terms and expressions used herein do not eliminate any equivalents of features illustrated and mentioned herein, and allow various modifications falling within the claimed scope of the present invention. The present invention may be embodied in many different forms. The present disclosure is to be considered as providing examples of the principles of the invention. These examples are described herein with the understanding that such examples are not intended to limit the present invention to preferred embodiments described herein and/or illustrated herein. Hence, the present invention is not limited to the preferred embodiments described herein. The present invention includes any and all preferred embodiments including equivalent elements, modifications, omissions, combinations, adaptations and/or alterations as would be appreciated by those skilled in the art on the basis of the present disclosure. The limitations in the claims are to be interpreted broadly based on the language included in the claims and not limited to examples described in the present specification or during the prosecution of the application.

While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

What is claimed is:

**1**. A vehicle comprising:

a body frame;

a first seat including a first seating portion supported by the body frame and on which an occupant sits;

a second seat including a second seating portion supported by the body frame and on which an occupant sits, the second seat being disposed rightward of the first seat;

an engine including a crankshaft extending in a front-rear direction of the vehicle, the engine being supported by the body frame and disposed rearward relative to the first and second seating portions;

a transmission configured to rotate by receiving a driving force from the crankshaft and including a main shaft provided with a plurality of first gears including a first axially movable gear, and a drive shaft provided with a plurality of second gears including a second axially movable gear and configured to intermesh with the first gears; and

a transmission case provided as a component separate from the engine and spaced away from the engine and in which the transmission is contained; wherein

at least a portion of the transmission case is disposed between the first and second seating portions, and above a lower end of the first seating portion and a lower end of the second seating portion.

**2**. The vehicle according to claim **1**, wherein the transmission further includes:

an input shaft disposed coaxially with the crankshaft and configured to rotate by receiving a driving force from the crankshaft; and

a clutch provided on the main shaft and to which a torque of the crankshaft is transmitted via the input shaft; wherein

the input shaft and the clutch do not overlap with each other in a front view of the vehicle.

**3**. The vehicle according to claim **2**, wherein the transmission further includes:

a third gear provided on the input shaft; and

a fourth gear provided on the clutch and configured to intermesh with the third gear; wherein

a diameter of the third gear is smaller than a diameter of the fourth gear.

**4**. The vehicle according to claim **2**, wherein the transmission further includes an output shaft configured to rotate by receiving a driving force from the drive shaft;

the output shaft extends in the vehicle front-rear direction and is connected to a propeller shaft configured to rotate by receiving a driving force from the output shaft; and

an axial center of the input shaft is disposed below an axial center of the main shaft and above an axial center of the output shaft.

**5**. The vehicle according to claim **2**, wherein the input shaft overlaps with the first seat or the second seat in a plan view of the vehicle.

**6**. The vehicle according to claim **2**, wherein the clutch is a multiplate wet clutch including a plurality of driving plates and a plurality of driven plates.

**7**. The vehicle according to claim **2**, further comprising:

a shift fork configured to engage with the first and second movable gears;

a shift drum provided with a groove with which the shift fork engages;

a rotation plate fixed to one end of the shift drum and configured to rotate together with the shift drum;

a shift lever that engages with the rotation plate;

a shift shaft fixed to the shift lever and extending in the vehicle front-rear direction;

a link member disposed in front of the transmission case and connected to the shift shaft; and

a shift operation lever fixed to the link member and by which a transmission gear ratio of the transmission is changed; wherein

the clutch is located rearward relative to the first and second movable gears.

**8**. The vehicle according to claim **2**, wherein the clutch is disposed rightward relative to a right end of the first seating portion and leftward relative to a left end of the second seating portion.

**9**. The vehicle according to claim **1**, wherein the engine and the transmission case overlap with each other in a front view of the vehicle.

**10**. The vehicle according to claim **1**, wherein the engine further includes a cylinder body including a plurality of cylinders arranged in the vehicle front-rear direction.

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